

Remarks

1. Applicant thanks the Examiner for his office action and hopes that this response will further the understanding of applicant's invention. Applicant further thanks the Examiner and his supervisor for the interview conduct August 22, 2005.
2. Applicant agrees with the interview summary provided by the Examiner with the following minor corrections:
 - a. The applicant name is Shoulamit C. Shwartz.
 - b. The exhibit shown was the book titled "Physics in Nuclear Medicine, Second Edition", James A. Sorenson and Michael E. Phelps, W.B. Saunders Company, Philadelphia, PA, 1987, ISBN 0-8089-1804-4, pages 307-309 and 424-425. Copies of those pages are submitted herewith in an accompanying Information Disclosure Statement.
3. Claims 1-5, 7-11, 13-24, 25-30, and 32 are pending in the application and stand rejected. Claims 6, 12, 25, and 31 have been cancelled and their limitations were incorporated in their respective independent claims.
4. Applicant confirms the Examiner's presumptions that the subject matter of the various claims were commonly owned at the time the invention was made due to an obligation to assign the invention to a single owner.
5. Several grammatical and syntactic mistakes have been corrected. A reference to a PCT application that was incorporate by reference has been amended to identify the US pending application. The application (presently allowed) is commonly owned by the owners of the present application.
6. Certain elements were re-arranged and more consistently underlined in Table 1. In the second row of the table, certain values of projection numbers were

doubly highlighted. Those values have been inadvertently omitted in the original specifications due to a typing error. Applicant submits that the added values are consistent with the rest of the table and the specifications, and therefore no new matter was introduced.

7. Applicant filed an information disclosure statement together with the present amendment, to show the general state of the art, as well as to bring to the Office attention certain references that were cited in the above mentioned commonly owned application. Applicant respectfully requests that the Office will consider the cited references.
8. The present invention is directed to a method of shortening acquisition time for obtaining a reconstructed diagnostic image. A dosage of radiopharmaceutical substance radiating gamma rays is administered to a patient, as known. SPECT (single photon emission computerized tomography) is used to provide the diagnostic image. However, in order to ameliorate the problem of lengthy acquisition time of a complete diagnostic image, the present invention uses algorithms that allow obtaining a diagnostic picture similar in quality to those available at the time the invention was made, however at a significantly shorter time. This result is generally enabled by the use of an iterative reconstruction algorithm. An example of such algorithm was described in US application No. 10/333,947, originally incorporated by reference in the original specifications. The invention utilizes a well-known camera type that has an elongated multiple-bore collimator, as commonly used today, however the use of an iterative algorithm allows the reconstruction of diagnostic image from data acquired in reduced total acquisition time. Applicant amended all

independent claims to provide a more complete description of the computational elements that offer the improved results.

9. Claims 1-5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Bennett et al. (US H12) in view of Juni (US 2003/0136912).

10. Applicant amended claim 1 and all its dependent claims to more clearly show that the present invention utilizes a collimator having multiple elongated bores. (As stated in paragraph [0056] elongated multiple-bore collimators are not limited to round cylinders, but extend to collimators with various shaped bores, and the cylindrical bores themselves may be arranged in a parallel, conic, or other converging shape.) This is in clear differentiation from the Bennett reference which clearly directed to multi pinhole based collimators, and large field of view cameras. (abstract, claim 1, col. 2, ll. 19 and ll. 31, and elsewhere). Substitution of the cylindrical multiple-bore collimator with the pinhole collimator will significantly change the Bennett reference principle of operation, as a pinhole collimator is vastly different from a multi-bore collimator. In a pinhole collimator, substantially the entire volume of the imaged object is viewed through the same orifice (pinhole) creating an inverted image. Magnification of this image depends on the ratio between the detector-to-orifice and orifice-to-object distances. Due to these limitations, the pinhole collimator is specifically designed to image small objects.

In contrast, in a multi-bore collimator, only the parts of the object substantially in the line-of-sight of the bore (and the inherent solid angle) are viewed by the detector creating an erect image. Moreover, it is easy to form a seven-pinhole collimator (as disclosed in Bennett), creating seven smaller images of the object on the same detector. In a multi-bore collimator, only one image of the object is projected over the detector. Thus, replacing the multiple-pinhole collimators disclosed by Bennett with a multi-bore collimators will impermissibly alter the principle of operation of the Bennett reference, as well as impermissibly render

the Bennett reference unsatisfactory for its intended purpose. The differences between the pinhole and the multiple elongated bore collimators are well known, as can be viewed for example in "Physics in Nuclear Medicine", James A. Sorenson 1987, pp. 307-309, W.B. Saunders Company, Philadelphia, PA, ISBN 0-8089-1804-4.

11. For all the reasons detailed above, applicant respectfully submits that the Bennett reference is non-relevant to the present application as claimed, and should be removed.
12. The Office further asserted that the Juni reference discloses a SPECT system wherein the angular projections are separated by an angle larger than 5 degrees. Applicant respectfully disagrees and directs the Examiner's attention that the claim limitation requires "acquiring **adjacent** angular projections separated by at least 5 degrees" (emphasis added). The Juni reference is directed to a SPECT system which places a plurality of aperture slots interposed between a plurality of detectors and a patient field of view. The aperture slots and detectors are movable relative to each other and thus permit each detector to cover a certain portion of the total field of view to be scanned by the detector element, in a series of 'lines of response' ([0077]-[0078], and elsewhere). Therefore, the Juni invention may be considered as equivalent to a plurality of cameras with movable collimators that change the direction in which the camera 'looks', where each camera is placed along an arc. Clearly the 'lines of response' are equivalent to 'projections' in the present application. However, Juni further states that *"The aperture arc preferably moves continuously, such that the lines of response "sweep" over the field of view. Alternatively, the aperture arc may move in discrete steps, with imaging occurring with the arc stopped at each of the steps."* ([0082]). Applicant read carefully the Juni reference, but failed to find anywhere therein any disclosure, hint or suggestion to **adjacent** projections separated by at least five degrees. Therefore, neither the Juni reference, nor the Bennett reference, disclose all claim limitations. Applicant therefore

respectfully submits that the rejection is improper and request that it will be reconsidered and withdrawn.

13. In light of the above, applicant further submits that the rejection of claims 2-5 should be similarly reconsidered and withdrawn, as Juni fails to disclose the claimed ranges.
14. Claim 7, 8, 11, 15, and 26 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Bennett in view of Perez-Mendez (US 5,596,198). Claim 7 was amended in a similar manner to claim 1, and therefore applicant submits that Bennett is similarly non-relevant to the present claim.
15. Perez Mendez is directed to a gamma ray camera that includes a sensor array for converting gamma rays to visible light photons and a photo sensor array for forming an electronic image of the radiation. The photosensor array is adapted to record an integrated amount of charge proportional to the incident gamma rays closest to it.
16. The Office rejected claims 7 and 14 under 35 U.S.C. §103(a) citing Col. 7 ll. 28-37 of Perez-Mendez as disclosing the claim limitation of an 'acquisition time'. However, applicant respectfully directs the Office attention to the fact that the claim limitation is directed to the acquisition time, required for acquiring the diagnostic image. As it seem that the Office have mistakenly interpreted the claim limitation, applicant clarified the meaning of the term within the claim. The Office stated that Perez Mendez discloses a gamma ray camera capable of obtaining an image with an acquisition time less than 20 minutes. Applicant points out that a diagnostic image may be formed only using a plurality of projections. Perez Mendez describes in the cited passage merely the fact that *"It has been experimentally determined that decay constants of a few tens of seconds with a photodiode capacitance of between 10*

and 100 pF were obtained and a gamma ray imaging with a 20 second integration time was achieved. In Nuclear medicine, about 10^6 gamma rays are detected by a gamma camera during approximately 3 minutes of acquisition period. Using this configuration of the camera 10 with pixel size of 1 mm X 1 mm X 1 μ m (105 pF), nine successive readouts with 20 second-integration interval are needed to acquire data for a total acquisition period of 3 minutes."

Clearly Perez Mendez merely describes the performance characteristics obtained by his camera using a specific configuration of integrating capacitor, and specifying the number of captured rays within a specific amount of time. Perez-Mendez does not state that this amount of time, either 3 minutes or 20 seconds, is sufficient to acquire an image, nonetheless an image with clinical diagnostic value. The paragraph merely states that using a 20 second integration interval allowed his camera, and that 9 such intervals are needed to detect 10^6 gamma rays within 3 minutes. Applicant respectfully submits that the cited reference, separately or in combination, fail to show all of the claim limitation. Therefore applicant submits that the rejection of claims 7, and 14, and their dependent claims was improper. Reconsideration and withdrawal of the rejection is respectfully requested.

17. Applicant further directs the Examiner's attention to the fact that claims 15-18 are directed to bone SPECT, claims 19-20 are directed to cardiac imaging, and claims 23-24 are directed to Medium Energy Oncology SPECT. Applicant respectfully submits that the claimed acquisition times with the claimed isotope and equipment, have not been achievable at the time the invention was made for the intended diagnostic purpose claimed. It is due to the contribution of the applicant as disclosed in present application which allowed production of meaningful diagnostic images within the claimed time.

18. Claims 16-22 stand rejected under 35 U.S.C. §103(a) as unpatentable over Bennett in view of Perez-Mendez, and further in view of Jeanguillaume (US

5,448,073). Applicant respectfully submits that the arguments made against the relevance of both Perez-Mendez and Bennett are applicable herein and for brevity those arguments shall not be repeated here.

19. Jeanguillaume is directed to a high sensitivity gamma camera, which uses detector crystals. Detector crystals are the portion of the detector upon which gamma photons impinge, to cause scintillation effects or otherwise be converted to an electrical signals. The skilled in the art will recognize that the term 'detector crystal' is commonly used in the art to denote many types of materials that perform this function, some of which may not be strictly crystals. The use of a plurality of detector crystals within a single detector is also well known. Applicant respectfully submits that the Office misinterpreted the term 'detector' as used within the present invention, to mean the detector crystal. To assist in preventing this semantic misunderstanding, applicant amended the claim to more distinctly show that the detector crystal is but one component of the detector, which further comprises a collimator, and other components commonly associated with a gamma radiation detector.

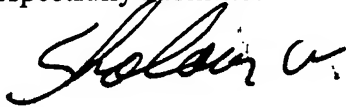
20. Claims 23 and 24 stand rejected under 35 U.S.C. §112, as being indefinite. The Office suggested that the term "Medium Energy" is a relative term which renders the claim indefinite. Applicant respectfully disagrees. Firstly, the claim term used is 'Medium Energy ONCOLOGY'. This term has been clearly defined in Table 1 of the specifications, as filed. In the last row of the table, Medium Energy Oncology is defined as using isotopes such as Gallium, Indium, or Iodine. Moreover, in the Information Disclosure Statement submitted herewith, applicant submitted several authorities in the field of clinical nuclear imaging, which use, and generally bound the term. Applicant respectfully submits that the term is well known and defined in the art to relate generally to energy levels in the range of about 180-360 keV. Applicant therefore submits that as the term is well known, and furthermore the specifications as filed

contain clear and full support to select examples of the term, that the rejection is improper and should be rescinded.

21. Claims 27-30 stand rejected as being unpatentable under 35 U.S.C. §112 as being indefinite in light of the term 'clinically acceptable acquisition time' which the Office deemed a relative term that will not allow one of ordinary skill in the art to reasonably appraise the scope of the invention. Applicant respectfully disagrees and submits that the term is clearly within the scope of the one skilled in the art. In addition to the examples provided in Table 1, one can refer to a large number of authorities in the field, some of which are provided in the accompanying Information Disclosure Statement. Examples of such authorities in the field include the American College of Cardiology/American Heart Association Task Force on Practice Guidelines, in a paper titled "ACC/AHA/ASNC Guidelines for the Clinical Use of Cardiac Radionuclide Imaging" (page 42, under the heading 'Image Acquisition'), and the American College of Radiology "ACR Guidelines for the Performance of Tumor Scintigraphy", (page 555, under the heading Specifications of the Examination), as well as in other sources. The term clinically acceptable acquisition time clearly has a different minimal value for each type of diagnostic procedure, but will be clearly recognized by a person of ordinary skill in the art, for the purpose of defining the scope of the invention at the time the invention was made.
22. The Office indicated that claims 32 is also rejected, but provided no reasons for the rejection. Applicant respectfully requests that the rejection be substantiated or withdrawn.

23. Applicant has made a good faith effort to address each and every point made by the Examiner, and amended the claim and the specifications in order to place the application in condition for allowance. Should the Examiner find any deficiency in this amendment or in the application, or should the Examiner believe for any reason, that a conversation with applicant's agent may further the allowance and issuance of this application, the Examiner is kindly requested to contact Shalom Wertsberger at telephone (207) 799-9733.
24. In light of the showing and all other reasons stated above, applicant believes that the rejections and objections presented by the Examiner in the office action mailed to applicant March 9, 2005 were overcome. Applicant therefore submits that the claims as amended are in condition for allowance. Reconsideration and withdrawal of the rejection and issue of a notice of allowance on all pending claims is respectfully solicited.

Respectfully submitted



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